92. Neuropathy/myopathy

Table 92 gives details of the studies found which investigated lung cancer in relation to neuropathies and myopathies. One relative risk of 12.51 was estimated from one study, while a total of 28 cases of lung cancer associated with various neurological disorders were reported from the other studies.

With so few estimates of risk, it is difficult to assess the possible association between lung cancer and neuropathies and myopathies. Howeve, one author felt that it was unlikely that the neurological changes were due to any general toxic effect of the tumour, but were more likely to be due to some exceptional factor either in relation to the tumour or in the subject's reaction to it [1].

Table 92: Estimates of relative risk for neuropathy/myopathy

Study	Population	Relative risk (95% limits)
Denny-Brown (1948)	UK men	2 cases of lung cancer with sensory neuropathy
Wyburn-Mason (1948)	UK male	1 case of lung cancer with sensory neuropathy
Lennox and Prichard (1950)	UK men	5 cases of peripheral neuritis among 299 bronchial carcinoma cases
Brain et al (1951)	UK residents	2 cases of bronchial carcinoma associated with subacute cortical cerebellar degeneration
Henson et al (1954)	UK residents	17 cases of bronchial carcinoma associated with various neurological disorders
Croft (1958)	UK female	1 case of lung cancer associated with neuropathy
Croft and Wilkinson (1963)	UK residents	12.51(3.81-41.08)[1]

1 Estimated from data given

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. Brain WR (1963) The neurological complications of neoplasms. Lancet, 1, 179-184.

2. Brain WR, Daniel PM and Greenfield JG (1951) Subacute cortical cerebellar degeneration and its relation to carcinoma. J Neurol Neurosurg Psychiat, 14, 59-75.

3. Croft PB (1958) Abnormal responses to muscle relaxants in carcinomatous neuropathy. Br Med J, 1, 181-187.

4. Croft PB and Wilkinson M (1963) Carcinomatous neuromyopathy: Its incidence in patients with carcinoma of the lung and carcinoma of the breast. Lancet, 1, 184-188.

5. Denny-Brown D (1948) Primary sensory neuropathy with muscular changes associated with carcinoma. J Neurol Neurosurg, 11, 73-87.

6. Henson RA, Russell DS and Wilkinson M (1954) Carcinomatous neuropathy and myopathy: A clinical and pathological study. Brain, 77, 82-121.

7. Lennox B and Prichard S (1950) The association of bronchial carcinoma and peripheral neuritis. Quart J Med, 19, 97-109.

8. Wyburn-Mason R (1948) Bronchial carcinoma presenting as polyneuritis. Lancet, i, 203-206.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

93. Neuroticism

Table 93 gives details of the four studies found which attempted to relate lung cancer risk to measures of neuroticism. One study calculated mortality rates per 100,000 men of 296, 108 and 56 for neuroticism scores of 0-2, 3-8 and 9+ respectively. The other three studies reported that lung cancer cases had lower neuroticism scores than the control groups, but did not give details of their results.

It should be noted that all of the studies were of a retrospective design and therefore collected information from the cases after they had developed cancer, although they may still have been unaware of their diagnosis at that stage. However, it is possible that their disease status may have affected their personality in some way, thus introducing bias into the results. Studies of prospective design would not have suffered from this particular problem. Therefore, although the findings presented in the table provide some evidence of a possible association between lung cancer risk and a low level of neuroticism, with only four studies reporting, such a relationship is far from proven.

Table 93: Estimates of mortality rates for neuroticism

Study	Population	Mortality rate
Kissen and Eysenck (1962)/Kissen (1963)	Scottish men	Lung cancer patients had lower neuroticism scores than controls
Kissen (1964)	Scottish men, neuroticism score 0-2	296[1]
	Score 3-8	108[1]
	Score 9+	56[1]
Kissen (1967)	Scottish men, aged 55-64	Lung cancer patients with and without, and controls without, history of adverse life events had lower neuroticism scores than controls with history of adverse life events

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Table 47a continued

Jain et al (1990)	C-C	Canada	Cholesterol	1.55[3]
			Total fat	1.30
Fraser et al (1991)	PR	USA	Meat/fish/poultry	1.31(0.52-3.28)
			Milk	0.88(0.37-2.12)
Kesteloot et al (1991)	EC	34 countries	Dairy fat/lard	>1.00($p < 0.01$)[1]
				No association[2]
Knekt et al (1991)	PR	Finland	Cholesterol	1.03(0.58-1.85)[1]
			Total fat	1.55(0.78-3.10)[1]
			Saturated fat	1.64(0.84-3.19)[1]
			Monounsat. fat	1.07(0.56-2.05)[1]
			Polyunsat. fat	0.87(0.50-1.52)[1]
			P/S ratio	0.71(0.44-1.12)[1]
Shekelle et al (1991)	PR	USA	Cholesterol	1.94[1]
Xie et al (1991)	EC	29 countries	Animal fat	6.30(1.86-10.7)[5,6]
				16.2(9.19-23.2)[5,7]
Goodman et al (1992)	C-C	USA	Dairy products	2.19(1.40-3.43)[3]
			Processed meats	2.35(1.83-3.01)[3]
			Eggs	1.31(0.85-2.03)[3]
			Desserts	2.12(1.40-3.20)[3]
			Fried foods	1.42(0.89-2.29)[3]

C-C = Case-control; EC = Ecological; PR = Prospective; P/S = ratio of polyunsaturated to saturated fat

1 Males only

2 Females only

3 Estimated from data for males and females separately

4 Data from 43 countries

5 Partial regression coefficient

6 Age group 55-64 years only

7 Age group 65-74 years only

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Table 47b: Measurements of serum cholesterol levels in lung cancer patients and controls (Males only unless otherwise indicated)

Study	Location	Average cholesterol difference between cases and controls	Significance of difference
Kagan et al (1981)	USA	-20.30 mg/dl	$p < 0.01$
Law and Thompson (1991)	Various[1]	-0.181 mmol/l	$p > 0.05$[2]
		-0.041 mmol/l	$p > 0.05$[3]
		-0.106 mmol/l	$p > 0.05$[2,4]
		-0.032 mmol/l	$p > 0.05$[3,4]
		Cholesterol level	Relative risk (95% limits)
Knekt et al (1991)	Finland	215-248 mg/dl	0.80(0.40-1.50)
		249-285 mg/dl	1.10(0.60-1.80)
		>285 mg/dl	1.30(0.80-2.20)
Shekelle et al (1992)	USA	<5.53 mmol/l	0.90($p > 0.05$)
		5.53-6.13 mmol/l	0.70($p > 0.05$)
		6.14-6.90 mmol/l	1.00($p > 0.05$)
		≥6.91 mmol/l	1.00($p > 0.05$)

1 Combined results from 33 prospective studies

2 Short term studies (cancers presenting in first 5 years in mortality studies or first 2 years in incidence studies)

3 Long term studies (cancer presenting after 5 years in mortality studies or after 2 years in incidence studies)

4 Females only

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Table 94: Estimates of relative risk/standardized mortality ratio for exposure to nickel and/or nickel compounds

Study	Population	Relative risk (95% limits)
Loken (1950)[1]	Norwegian nickel refinery workers	3 cases of lung cancer between 1948-1950
Rockstroh (1958)[1]/ Konetzke (1974a,b)[1]	German Democratic Republic nickel refinery workers	>1.00($p<0.05$)
Znamenskii (1963)[1]/ Tatarskaya (1965,1967)[1]	USSR nickel refinery workers	>1.00($p<0.05$)
Tsuchiya (1965)[1]	Japanese nickel refinery workers	>1.00($p<0.05$)
Mastromatteo (1967)[1]/ Virtue (1972)[1]/ CMBEEP (1975)[1]	Canadian nickel refinery workers	92 cases of lung cancer between 1948-1968
Saknyn and Shabynina (1970,1973)[2]	USSR nickel smelter workers A	200*
	B	280*
	C	380*
	D	400*
Bernacki et al (1978)[4]	Aircraft-engine factory workers	1.00
Lessard et al (1978)[4]/ Langer et al (1982)[4]/ Meininger et al (1982)[4]	New Caledonian nickel smelting workers	>1.00
Silverstein et al (1981)[2]	US die-casting/electroplating plant workers	191(127-276)[5]
Olejar et al (1982)[4]	Slovakian nickel smelting workers	>1.00
Andersson et al (1984)[2]	Swedish nickel-cadmium battery factory workers	120(44-261)*
Cornell (1984)[2]	US stainless steel/low-nickel alloy plant workers	97(85-111)[5]
Cornell and Landis (1984)[2]	US nickel-chromium alloy foundry workers	105(80-135)[5]

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Table 94 continued

Egedahl and Rice (1984)[2]	Canadian nickel refinery workers	83(10-301)[6]
Gerin et al (1984)[2]	Canadian patients	3.1(1.9-5.0)
Redmond (1984)[2]	US high-nickel alloy workers	109(98-122)*
Roberts et al (1984)[2]	US/Canadian nickel refinery workers	261(220-306)*
Sorahan (1987)[2]	UK nickel-cadmium battery factory workers	130(107-157)*
	UK nickel-chromium plating factory workers	150(117-189)*
ICNCM (1990)[2]	Canadian nickel miners and smelters	135(111-162)*
	Welsh nickel refinery workers	393(336-456)*
	Norwegian nickel refinery workers	262(207-327)*
	US nickel miners and smelters with <1 year exposure	265(107-546)*
	≥1 year exposure	127(77-196)*
	US high-nickel alloy workers	97(80-121)*
	UK high-nickel alloy workers	98(57-121)*
	US gaseous diffusion plant workers	54(25-103)*

* Standardized mortality ratio

1 From International Agency for Research on Cancer (1976)

2 From International Agency for Research on Cancer (1990)

3 Estimated from data given

4 From International Agency for Research on Cancer (1987)

5 Proportional mortality ratio

6 Standardized incidence ratio

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. International Agency for Research on Cancer (1976) Monographs on the evaluation of the carcinogenic risk of chemicals to humans. Volume 11: Cadmium, nickel, some epoxides, miscellaneous industrial chemicals and general considerations on volatile anaesthetics, 75-114. IARC, Lyon.

2. International Agency for Research on Cancer (1987) Monographs on the evaluation of carcinogenic risks to humans. Supplement 7: Overall evaluations of carcinogencity: An updating of IARC monographs volumes 1 to 42, 264-269. IARC, Lyon.

3. International Agency for Research on Cancer (1987) Monographs on the evaluation of carcinogenic risks to humans. Volume 49: Chromium, nickel and welding, 257-446. IARC, Lyon.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

95. Overnutrition

Table 95 gives details of the only study found which investigated the possible association between lung cancer risk and overnutrition. A relative risk of 1.16 was estimated for subjects in the highest category of energy intake.

Although other studies [1,2,4] have reported decreased risks of lung cancer in animals following dietary restriction, with only one study presenting data for humans it is not possible to make a proper evaluation.

Table 95: Estimate of relative risk for overnutrition

Study	Population	Relative risk (95% limits)
Knekt et al (1991)	Finnish men	1.16(0.73-1.82)

References

1. Doll R (1978) Nutrition and cancer: a review. Nutr Cancer, 1, 35-45.

2. Editorial (1982) Obesity: The cancer connection. Lancet, 1, 1223-1224.

3. Knekt P, Seppanen R, Jarvinen R et al (1991) Dietary cholesterol, fatty acids, and the risk of lung cancer among men. Nutr Cancer, 16, 267-275.

4. Roe FJC (1979) Food and cancer. J Human Nutr, 33, 405-415.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

96. Painters

Numerous studies have attempted to relate the risk of lung cancer to employment as a painter or related trade, and details of these studies are given in Table 96. Twenty-one standardized mortality ratios were calculated, ranging from 63-334, with 17 of them being raised. Fourteen relative risks, of between 0.7 and 4.2 were estimated, with all but one being above 1.00. Six studies gave proportional mortality ratios, lying in the range 112-184. Additionally, two proportional registration ratios, of 128 and 129, were given, along with a standardized proportional incidence ratio of 149, a standardized incidence ratio of 199, and a mortality rate of 2.5 per 1000 per year, although no details about the comparison group this was based on were given.

Although several of the studies attempted to classify the subjects' exposures by using indices such as length of employment or estimated level of exposure (Bertazzi, Chiazze, Dalager, Engholm and Englund, Levin, Lundberg, Morgan, Viadana et al), none appear to have made objective measurements. A wide range of potential occupational health hazards is present in relation to the manufacture and use of paints, varnishes and lacquers. It has been reported that over 3000 individual paint components are used worldwide, which can be broadly classified as organic solvents, organic and inorganic pigments, extenders, resins and additives such as catalysts, surfactants, driers, plasticizers and biocides [3]. Only three studies (Bertazzi, Siemiatycki, Stockwell and Matanoski) made any attempt to identify the substances workers were exposed to, but these were limited to asbestos (Bertazzi, Stockwell and Matanoski), chromate (Bertazzi) and white spirit (Siemiatycki). Additionally, Blot (1984) suggested that the increased lung cancer death rate reported in the study by Dalager may be associated with the use of zinc chromate primer paints [1]. It is likely that workers are exposed to many potentially carcinogenic compounds, and separating out the effects of any one of them will be very difficult. Differences between the studies in the length of employment as a painter necessary to be classified as "exposed" introduced further inaccuracies.

Despite these possible problems, the results presented here do seem to be consistent with an increase in lung cancer risk among those employed as painters, or in allied industries. Indeed, IARC classified

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

the evidence for painters as "sufficient", although felt that the evidence for a carcinogenic effect of paint manufacture was "inadequate" [3].

Table 96: Estimates of relative risk/standardized mortality ratio for painters

Study	Population	Relative risk (95% limits)
Breslow et al (1954)[1]	US construction/maintenance painters	1.9(0.93-3.8)
OPCS (1958)[1]	UK male painters/decorators	149($p<0.01$)*
Guralnick (1963)[1]	US male painters/plasterers	155($p<0.01$)*
Dunn and Weir (1965)[1]	US painters/decorators	129*
Boucot et al (1972)	US painters/plasterers/ paperhangers	2.5[2]
OPCS (1972)[1]	UK male painters/decorators	143($p<0.01$)*
Menck and Henderson (1976)[1]	US painters	158($p<0.01$)*
Viadana et al (1976)[1]/ Decoufle et al (1977)[1]/ Houten et al (1977)[1]	US painters	1.7($p=0.02$)
Williams et al (1977)[1]	US painters/construction workers/paperhangers/pattern and model makers	4.2($p<0.01$)
OPCS (1978)	E/W male painters/decorators aged 15-64	112($p<0.01$)[3]
	Aged 65-74	118($p<0.01$)[3]
	Incidence 1966-7	128($p<0.01$)[4]
	1968-9	129($p<0.01$)[4]
Chiazze et al (1980)[1]	US male spray painters	141[3]
Dalager et al (1980)[1]	US male spray painters	184($p<0.05$)[3]
Englund (1980)[1]/Engholm and Englund (1982)[1]	Swedish painters union members	127($p<0.01$)*
Petersen and Milham (1980)[1]	US male painters	>100[3]

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Table 96 continued

Bertazzi et al (1981)[1]	Italian paint manufacturers	334(106-434)*
Morgan et al (1981)[1]	US male workers in paint/ coating manufacture	98*[5]
Logan (1982)	UK male painters/decorators,1931	117*
	1951	149*
	1961	145*
	1971	136*
	Married women[6] - 1931	82*
	1951	90*
	1961	114*
	1971	142*
Milham (1983)[1]	US painters/paperhangers/ decorators	140($p<0.05$)[3]
Milne et al (1983)[1]	US male painters	1.7($p<0.05$)
	Workers in paint manufacturing	0.7
Whorton et al (1983)[1]	US painters	199(112-330)[7]
Dubrow and Wegman (1984)[1]	US male painters	131*
Stockwell and Matanoski (1985)[1]	Usual occupation painter	2.8(1.5-5.2)
	Ever worked as painter	2.6(1.3-4.9)
Kjuus et al (1986)[1]	Norwegian painters/paperhangers	1.7(0.4-7.3)
	Exposure to paint/glue/lacquer	1.2(0.6-2.6)
Lundberg (1986)[1]	Swedish male workers in paint manufacture	63(12-184)*
Matanoski et al (1986)[1]	US painters	118(106-132)*
OPCS (1986)	UK male painters/decorators/ french polishers	144($p<0.01$)*
	Married women[6]	151($p<0.01$)*
Lerchen et al (1987)[1]	US construction painters	2.7(0.8-8.9)
Olsen and Jensen (1987)[1]	Danish construction painters	149(119-185)[8]
Siemiatycki et al (1987a,b)[1]	Canadian construction painters	1.4
Levin et al (1988)[1]	Chinese male painters	1.4(0.5-3.5)
Ronco et al (1988)[1]	Italian male painters	1.3(0.43-4.1)
Keller and Howe (1993)	US construction workers	1.35(0.78-2.34)

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Footnote to Table 96

* Standardized mortality ratio
1 From International Agency for Research on Cancer (1989)
2 Per 1000 per year
3 Proportional mortality ratio
4 Proportional registration ratio
5 Tumours of respiratory tract
6 According to husband's occupation
7 Standardized incidence ratio
8 Standardized proportional incidence ratio

References

1. Blot WJ (1984) Lung cancer and occupational exposures. In: Lung cancer: Causes and prevention, 47-64. Verlag Chemie International Inc.

2. Boucot KR, Weiss W, Seidman H, Carnahan W and Cooper DA (1972) The Philadelphia pulmonary neoplasm research project: basic risk factors of lung cancer in older men. Am J Epidemiol, 95, 4-16.

3. International Agency for Research on Cancer (1989) Monographs on the evaluation of carcinogenic risks to humans. Volume 47: Some organic solvents, resin monomers and related compounds, pigments and occupational exposures in paint manufacture and painting, 329-443. IARC, Lyon.

4. Keller JE and Howe HL (1993) Cancer in Illinois construction workers: A study. Am J Ind Med, 24, 223-230.

5. Logan WPD (1982) Cancer mortality by occupation and social class 1851-1971. HMSO, London and IARC, Lyon.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

6. Office of Population Censuses and Surveys (1978) Occupational mortality: The Registrar General's decennial supplement for England and Wales, 1970-72. HMSO, London.

7. Office of Population Censuses and Surveys (1986) Occupational mortality: The Registrar General's decennial supplement for Great Britain, 1979-80, 1982-83. HMSO, London.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

98. Petroleum refining

Table 98 gives details of the 14 studies which attempted to relate lung cancer risk to occupational exposures in petroleum refining. Nine standardized mortality ratios were calculated, and these ranged from 78-190, with six of them being raised. Eight relative risks were also estimated, of between 0.42-2.00, and five of these were above 1.00. Additionally, one study reported a higher percentage of coal and petroleum workers among lung cancer cases.

There was a general lack of information on the exposures of the subjects, with most of the studies failing to make any objective measurements of workplace conditions. Only the studies by Bingham and Kaldor attempted to quantify exposure to petroleum and its products, the first by recording the duration of exposure, and the level of hydrocarbons workers were exposed to, and the second by estimating levels of air emissions. It is obvious then that inaccuracies in exposure classification could have been introduced into the other studies. Furthermore, workers in the petroleum refining industry are exposed to a number of substances, including ortho-anisidine, para-anisidine, arsenic compounds, asbestos, benzene, bitumens, 1,3-butadiene, carbazole, chlorinated hydrocarbons, chromium and chromium compounds, 1,2-dibromoethane, 1,2-dichloroethane, hydrazine, lead and lead compounds, mineral oils, nickel and nickel compounds, para-phenylenediamine, polycyclic aromatic compounds and silica. However, without accurate exposure data it is not possible to attribute the observed increases in lung cancer to any one chemical. Other problems noted in the studies refer to overlap of cohorts and short duration of follow-up [2].

Several of the studies observed a decrease in lung cancer risk among the exposed subjects, and two reasons for this were suggested. Firstly, it is well known that occupational cohorts tend to have a lower mortality experience than the general population, due to the "healthy worker" effect, and it was felt that the deficit in cancer mortality observed in refinery workers is compatible with this effect [2]. Alternatively, restrictions on workplace smoking in certain occupations may have lead to

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

97. Palmar keratoses

Table 97 gives details of the only study found which attempted to relate the risk of lung cancer to the presence of palmar keratoses. A relative risk of 4.19 was estimated.

With so few studies reporting, it is not possible to determine whether the observed excess of lung cancer really does indicate an association with the presence of palmar keratoses. However, the p value for this study must be very small, so it is unlikely that the results arose simply by chance.

Table 97: Estimate of relative risk for palmar keratoses

Study	Population	Relative risk (95% limits)
Cuzick et al (1984)	UK hospital patients	4.19(2.16-8.13)

References

1. Cuzick J, Harris R and Mortimer PS (1984) Palmar keratoses and cancers of the bladder and lung. Lancet, 1, 530-533.

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a decrease in lung cancer mortality in such workers. Additional evidence for this hypothesis comes from the decreased mortality from non-malignant respiratory disease observed in some of the studies [1].

When evaluating the carcinogenicity to humans of occupational exposures in petroleum refining, IARC [2] described the evidence as "limited" for skin cancer and leukaemia, and "inadequate" for all other sites. A review of lung cancer risk factors by Blot [1] classified petroleum refining exposures only as "possible" carcinogens.

Table 98: Estimates of relative risk/standardized mortality ratio for workers in petroleum refining

Study	Population	Relative risk (95% limits)
Blot and Fraumeni (1976)[1]	US residents of petroleum industry counties	1.15
Menck and Henderson (1976)[2]	US men	Higher % of coal/petroleum workers among cases
Wigle (1977)[1]	Canadian petroleum refining workers	0.42(0.2-1.0)
Gottlieb et al (1979)[3]	US petroleum refining workers	1.3(0.88-1.8)
	Crude petroleum workers	1.6($p<0.05$)
Hanis et al (1979)[1]	Canadian refinery employees	120*
	Exposed to petroleum or products	190($p<0.05$)*
Bingham et al (1980)[2]	US refinery workers	1.00
	Canadian oil refinery workers	1.00
	Canadian oil company workers	2.00
Thomas et al (1980)[1]	US petroleum refinery/chemical plant workers	130($p<0.05$)*[4]
Rushton and Alderson (1981)[2]	UK refinery workers	78*[5]
Hanis et al (1982)[2]	US refinery workers	91*[5]
Thomas et al (1982)[2]	US refinery workers	110-145[6]

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Table 98 continued

Waxweiler et al (1983)[2]	US petrochemical manufacturing plant workers	78*[5]
Wen et al (1983)[1]	US white blue-collar oil company workers	110*
Kaldor et al (1984)[1]	US men exposed to petroleum/ chemical plant emissions	>1.00
Hanis et al (1985)[1]	US refinery/chemical plant workers	120*

* Standardized mortality ratio

1 From International Agency for Research on Cancer (1989)

2 From Blot et al (1984)

3 From Pickle et al (1984)

4 Tumours of respiratory system

5 Estimated from data given

6 Proportional mortality ratio

References

1. Blot WJ (1984) Lung cancer and occupational exposures. In: Lung cancer: Causes and prevention, 47-64. Verlag Chemie International Inc.

2. International Agency for Research on Cancer (1989) Monographs on the evaluation of carcinogenic risks to humans. Volume 45: Occupational exposures in petroleum refining; crude oil and major petroleum fuels, 39-117. IARC, Lyon.

3. Pickle LW, Correa P and Fontham E (1984) Recent case-control studies of lung cancer in the United States. In: Lung cancer: Causes and prevention, 101-115. Verlag Chemie International Inc.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

99. Phosphates

Details of the only study found which investigated a possible association between lung cancer risk and exposure to phosphates are given in Table 99. A relative risk of 1.20 was estimated from data given in the study.

No measurements were made of the levels of phosphates the study subjects were exposed to and without this information it is difficult to interpret the findings of the study. Results from more studies will be needed before an evaluation of the carcinogenicity of exposure to phosphates can be made.

Table 99: Estimate of relative risk for exposure to phosphates

Study	Population	Relative risk (95% limits)
Stockwell et al (1988)	Florida phosphate mining area residents	1.20(1.07-1.35)[1]

1 Estimated from data given

References

1. Stockwell HG, Lyman GH, Waltz J and Peters JT (1988) Lung cancer in Florida: Risks associated with residence in the central Florida phosphate mining region. Am J Epidemiol, 128, 78-84.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

30. Physical inactivity

Table 100 gives details of the two studies which attempted to investigate the possible association between lung cancer risk and lack of physical exercise. Three relative risks, ranging from 0.9-2.0, were estimated of which two were above 1.00.

Although beneficial effects of physical activity on cardiovascular disease have previously been reported [1], the relationship with lung cancer risk is still far from clear.

Table 100: Estimates of relative risk for physical inactivity

Study	Population	Relative risk (95% limits)
Albanes et al (1989)	US males taking little nonrecreational activity	2.0(1.2-3.5)
	Taking little recreational exercise	0.9(0.6-1.5)
Dosemeci et al (1993)	Turkish workers in sedentary jobs	1.1(0.9-1.3)

References

1. Albanes D, Blair A and Taylor PR (1989) Physical activity and risk of cancer in the NHANES I population. Am J Public Health, 79, 744-750.

2. Dosemeci M, Hayes RB, Vetter R et al (1993) Occupational physical activity, socioeconomic status, and risks of 15 cancer sites in Turkey. Cancer Causes and Control, 4, 313-321.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

101. Plumbers

The three studies which attempted to relate lung cancer risk to employment as a plumber are detailed in Table 101. Standardized mortality ratios of between 67 and 144 were calculated, with eight out of nine being raised. Additionally, two proportional mortality ratios of 103 and 106 and two proportional registration ratios of 123 and 131 were also presented.

None of the studies gave any information on possible exposures plumbers might be subjected to, and no hypotheses were put forward to explain the observed increase in lung cancer risk. Therefore, it is not really possible to properly evaluate the potential risk of employment as a plumber, but from the evidence presented in the table it appears that if a risk does exist it is probably not very large.

Table 101: Estimates of standardized mortality ratio for employment as a plumber

Study	Population	Standardized mortality ratio
OPCS (1978)	English/Welsh plumbers/gas fitters/lead burners, aged 15-64	106*
	Aged 65-74	103*
	Incidence 1966-7	123($p<0.01$)[1]
	1968-9	131($p<0.01$)[1]
Logan (1982)	English/Welsh men, 1931	67
	1951	125
	1961	124
	1971	126
	Married women[2], 1951	144
	1961	109
	1971	135
OPCS (1986)	UK male plumbers/heating/ventilation/gas fitters	142($p<0.01$)
	Married women[2]	120

2501209037

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Footnote to Table 101

* Proportional mortality ratio

1 Proportional registration ratio

2 According to husband's occupation

References

1. Logan WPD (1982) Cancer mortality by occupation and social class 1851-1971. HMSO, London and IARC, Lyon.

2. Office of Population Censuses and Surveys (1978) Occupational mortality: The Registrar General's decennial supplement for England and Wales, 1970-72. HMSO, London.

3. Office of Population Censuses and Surveys (1986) Occupational mortality: The Registrar General's decennial supplement for Great Britain, 1979-80, 1982-83. HMSO, London.

2501209038

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

102. Pneumonia

Table 102 gives details of the studies found which gave data relevant to an investigation of the possible association between lung cancer risk and pneumonia. Three relative risks were estimated, ranging from 1.00-1.70, with two being above 1.00. In addition, one study reported that pneumonia sufferers were 100 times more likely than the general population to develop lung cancer.

With the exception of the study by Ohtsuka, in which a group of pneumonia patients were followed-up in order to determine their lung cancer incidence, none of the studies appeared to have used medical records to determine the disease history of the subjects, relying instead on information supplied at interview by the respondents, or next-of-kin. It is obvious that this could have lead to inaccuracies due to mistakes in recalling disease status, particularly in those studies which collected health data from a surrogate respondent.

This fact, combined with the small number of studies providing data, makes it difficult to properly evaluate the possible association between lung cancer risk and pneumonia.

Table 102: Estimates of relative risk for history of pneumonia

Study	Population	Relative risk (95% limits)
Wynder et al (1956)	US women	1.00
Wynder and Fairchild (1966)	US men	1.70(0.99-2.93)[1]
Alavanja et al (1992)	US female residents	1.2(1.0-1.6)
Ohtsuka et al (19??)	Japanese men	Pneumonia sufferers 100 times more likely to develop lung cancer than general population

1 Estimated from data given

2501209039

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. Alavanja MCR, Brownson RC, Boice JD and Hock E (1992) Preexisting lung disease and lung cancer among nonsmoking women. Am J Epidemiol, 136, 623-632.

2. Ohtsuka Y, Tanimura K, Munakata M et al (19??) Idiopathic interstitial pneumonia(IIP) as a risk factor for a lung cancer - a prospective study. Incomplete reference.

3. Wynder EL, Bross IJ, Cornfield J and O'Donnell WE (1956) Lung cancer in women: A study of environmental factors. N Engl J Med, 255, 1111-1121.

4. Wynder EL and Fairchild EP (1966) The role of a history of persistent cough in the epidemiology of lung cancer. Am Rev Resp Dis, 94, 709-720.

2501209040

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

103. Polychlorinated biphenyls

Table 103 details the two studies found which attempted to relate lung cancer risk to exposure to polychlorinated biphenyls (PCBs). One standardized mortality ratio, of 320, was calculated, while the other study reported two cases of lung cancer among exposed subjects.

It was reported that the subjects in these studies were not exposed to PCBs alone, but that the contaminated rice oil to which they were exposed also contained polychlorinated quaterphenyls and polychlorinated dibenzofurans. It is possible that one or both of these substances was responsible for the excess of lung cancers observed.

Because of the lack of knowledge of the role of these contaminants, IARC described the evidence for the carcinogenicity of PCBs to humans as "limited" [2].

Table 103: Estimates of standardized mortality ratio for exposure to polychlorinated biphenyls

Study	Population	Standardized mortality ratio
Urabe (1974)[1]/Kuratsune (1976)[1]	Japanese Yusho patients	2 lung cancers observed
Kuratsune et al (1986)[2]	Japanese male Yusho patients	320[3]

1 From International Agency for Reseach on Cancer (1978)
2 From International Agency for Reseach on Cancer (1987)
3 Estimated from data given

2501209041

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. International Agency for Research on Cancer (1978) Monographs on the evaluation of the carcinogenic risk of chemicals to humans. Volume 18: Polychlorinated biphenyls and polybrominated biphenyls, 43-103. IARC, Lyon.

2. International Agency for Research on Cancer (1987) Monographs on the evaluation of carcinogenic risks to humans. Supplement 7: Overall evaluations of carcinogenicity: An updating of IARC monographs volumes 1 to 42, 322-326. IARC, Lyon.

2501209042

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

104. Postmen

Table 104 gives details of the studies which investigated a possible association between lung cancer risk and employment as a postman. Nine standardized mortality ratios, lying in the range 96-123, were calculated with all but one being raised. Two proportional mortality ratios, of 99 and 102, were given along with two proportional registration ratios of 111 and 118.

Although the data in the table appear to show a higher risk of lung cancer among postmen, the increase in risk does not appear to be very large. No data was available on possible exposures postmen might be subjected to, and there was no attempt by any of the studies to explain the observed increase in lung cancer risk. It should also be remembered that the data came from very few studies. Therefore, due to a lack of information it is not really possible to draw any firm conclusions about the risk of lung cancer among postmen.

Table 104: Estimates of standardized mortality ratio for employment as a postman

Study	Population	Standardized mortality ratio
OPCS (1978)	English/Welsh postmen/mail sorters, aged 15-64	99*
	Aged 65-74	102*
	Incidence 1966-7	118($p<0.01$)[1]
	1968-9	111[1]
Logan (1982)	English/Welsh postmen, 1931	110
	1951	113
	1961	117
	1971	96
	Married women[2], 1951	121
	1961	123
	1971	111
OPCS (1986)	UK male postmen/mail sorters/messengers	104
	Married women[2]	116

2501209043

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Footnote to Table 104

* Proportional mortality ratio

1 Proportional registration ratio

2 According to husband's occupation

References

1. Logan WPD (1982) Cancer mortality by occupation and social class 1851-1971. HMSO, London and IARC, Lyon.

2. Office of Population Censuses and Surveys (1978) Occupational mortality: The Registrar General's decennial supplement for England and Wales, 1970-72. HMSO, London.

3. Office of Population Censuses and Surveys (1986) Occupational mortality: The Registrar General's decennial supplement for Great Britain, 1979-80, 1982-83. HMSO, London.

2501209Hy

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

105. Printers

Only two studies were found which attempted to relate the risk of lung cancer to employment in the printing industry, and details of these are given in Table 105. Four standardized mortality ratios between 91 and 141 were presented, of which three were raised.

Neither study attempted to explain their findings, and indeed one of them stated that their survey did not "provide any evidence about the cause of the overall small excess of deaths from lung cancer, which might or might not be occupational" [1]. With so few studies reporting, it is difficult to draw any firm conclusions about the carcinogenicity of exposures associated with the printing industry, but it is likely that if a risk does exist it is not very large.

Table 105: Estimates of standardized mortality ratio for workers in the printing industry

Study	Population	Standardized mortality ratio
Moss et al (1972)	UK male printing trade workers - London	132($p<0.01$)
	Manchester	141($p<0.01$)
OPCS (1986)	UK male printing workers/screen/block printers	106
	Married women[1]	91

1 According to husband's occupation

2501209045

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. Moss E, Scott TS and Atherley GRC (1972) Mortality of newspaper workers from lung cancer and bronchitis 1952-66. Br J Ind Med, 29, 1-14.

2. Office of Population Censuses and Surveys (1986) Occupational mortality: The Registrar General's decennial supplement for Great Britain, 1979-80, 1982-83. HMSO, London.

2501209046

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

106. Publicans

Table 106 gives details of the two studies which gave information relevant to an investigation of the possible association between lung cancer and employment as a publican. Seven standardized mortality ratios of between 104 and 197 were presented. Two proportional mortality ratios of 101 and 105 were given, along with two proportional registration ratios of 118 and 122.

No data was available on possible exposures of publicans, and there was no attempt to explain the observed increase in lung cancer risk. Although the evidence suggests an increased risk of lung cancer among publicans, with so little information available it is difficult to properly evaluate the potential carcinogenicity of such employment.

Table 106: Estimates of standardized mortality ratio for publicans

Study	Population	Standardized mortality ratio
OPCS (1978)	E/W male publicans/innkeepers, aged 15-64	105*
	Aged 65-74	101*
	Incidence 1966-7	118($p<0.05$)[1]
	1968-9	122($p<0.01$)[1]
Logan (1982)	E/W men, 1931	146
	1951	144
	1961	142
	1971	153
	Married women[2], 1951	104
	1961	197
	1971	156

E/W = English/Welsh

* Proportional mortality ratio

1 Proportional registration ratio

2 According to husband's occupation

2501209H7

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. Logan WPD (1982) Cancer mortality by occupation and social class 1851-1971. HMSO, London and IARC, Lyon.

2. Office of Population Censuses and Surveys (1978) Occupational mortality: The Registrar General's decennial supplement for England and Wales, 1970-72. HMSO, London.

2501209048

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

107. Radiotherapy

Table 107 gives details of the two studies found which attempted to relate lung cancer risk to exposure to radiotherapy. Two relative risks, of 1.2 and 3.7, were estimated, along with a standardized mortality ratio of 142.

Only the study by Smith and Doll gave information on the doses of radiation received by respondents. Thus, in the study by Kabat inaccuracies could have been introduced due to misclassification of exposure. Furthermore, in this study there was a high correlation between a history of a reproductive primary and a history of radiotherapy, and it was not possible to estimate the effect of one exposure independent of the other.

In any case, with only two studies reporting it is difficult to evaluate the potential carcinogenicity of radiotherapy to humans.

Table 107: Estimates of relative risk/standardized mortality ratio for exposure to radiotherapy

Study	Population	Relative risk (95% limits)
Doll (1981)/Smith and Doll (1982)	UK ankylosing spondylitis patients	142($p<0.001$)*
Kabat (1993)	US male radiotherapy patients	1.2(0.2-6.4)
	Females	3.7(1.2-10.9)

* Standardized mortality ratio

2501209049

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. Doll R (1981) Radiation hazards: 25 years of collaborative research. Brit J Radiol, 54, 179-186.

2. Kabat GC (1993) Previous cancer and radiotherapy as risk factors for lung cancer in lifetime nonsmokers. Cancer Causes and Control, 4, 489-495.

3. Smith PG and Doll R (1982) Mortality among patients with ankylosing spondylitis after a single treatment course with x rays. Brit Med J, 284, 449-60.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

108. Radon

Lack of time meant that a full evaluation of the evidence relating lung cancer risk to radon exposure could not be made. However, both IARC and the National Research Council reviewed this area in 1988 [1,2]. Although radon is ubiquitous, concentrations to which humans may be exposed in enclosed areas, such as underground mines and in buildings, are elevated compared to levels in outdoor air. Evidence for an increased risk of lung cancer following exposure to radon comes from a number of cohort and case-control studies of underground miners, including particularly uranium miners, but also iron-ore and other metal miners, and one group of fluorspar miners. Evidence for dose-response relationships has been obtained from several of these studies. Additionally, a higher risk of lung cancer among individuals living in houses known or presumed to have higher levels of radon than among those with lower presumed exposure has been suggested by several case-control studies, although these have been based on small numbers of subjects. There is also some evidence that the interaction of radon and its decay products with cigarette smoking with regard to lung cancer may follow a multiplicative or submultiplicative model [1,2].

Overall, IARC felt that there was "sufficient" evidence of the carcinogenicity of radon and its decay products to humans [1].

References

1. International Agency for Research on Cancer (1988) Monographs on the evaluation of carcinogenic risks to humans. Volume 43: Man-made mineral fibres and radon, 173-259. IARC, Lyon.

2. National Research Council (1988) Health risks of radon and other internally deposited alpha-emitters: BEIR IV. National Academy Press, Washington DC.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

109. Rail workers

Only three studies were found which investigated a possible association between the risk of lung cancer and rail workers, and details of these are given in Table 109. The nine standardized mortality ratios presented ranged from 83-115, with five of them being raised.

It has been suggested that rail workers may be exposed to a number of compounds which may be carcinogenic, particularly asbestos [1,2]. The study by Howe attempted to relate the risk of lung cancer in rail workers to exposure to diesel fumes and coal dust, but estimates of the level of exposure were used in place of objective measurements. Apart from this, no information was available on the subjects' exposures, so it is not possible to determine the substances to which they may have been exposed, or the possible role of any one substance in the development of lung cancer.

Thus, it is very difficult to evaluate the evidence for the carcinogenicity of exposures of rail workers but from the data presented in the table a clear pattern of increased risk does not really emerge and therefore any risk, if it does exist, is probably not very large.

Table 109: Estimates of standardized mortality ratio for rail workers

Study	Population	Standardized mortality ratio
Logan (1982)	English/Welsh male railway porters - 1931	100
	1951	108
	1961	106
	1971	115
	Married women[1] - 1961	95
	1971	115
Howe et al (1983)	Canadian male rail workers	106
OPCS (1986)	UK male rail transport operating staff	87
	Married women[1]	83

1 According to husband's occupation

2501209052

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. Garshick E, Schenker MB, Munoz A et al (1987) A case-control study of lung cancer and diesel exhaust exposure in railroad workers. Am Rev Respir Dis, 135, 1242-1248.

2. Howe GR, Fraser D, Lindsay J, Presnal B and Yu SZ (1983) Cancer mortality (1965-1977) in relation to diesel fume and coal exposure in a cohort of retired railway workers. JNCI, 70, 1015-1019.

3. Logan WPD (1982) Cancer mortality by occupation and social class 1851-1971. HMSO, London and IARC, Lyon.

4. Office of Population Censuses and Surveys (1986) Occupational mortality: The Registrar General's decennial supplement for Great Britain, 1979-80, 1982-83. HMSO, London.

2501209053

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

110. Rationality/antiemotionality

Only two studies were found which attempted to relate lung cancer risk to measures of rationality and antiemotionality, and details of these are given in Table 110. One study reported that all 38 lung cancer cases occurred in those scoring highly for rationality and antiemotionality, compared to 11.62 expected, giving a standardized mortality ratio of 3.27, while the other reported that lung cancer patients showed higher prevalences of traits associated with rationality and antiemotionality than controls.

The study by Grossarth-Maticek has attracted much criticism since it was published, and the results are generally considered to be seriously flawed due to drawbacks in the study design and the method of recruiting respondents. Thus, with only one other study reporting it is not possible to evaluate the relationship between lung cancer risk and rationality and antiemotionality.

Table 110: Estimates of standardized mortality ratio for rationality/ antiemotionality

Study	Population	Standardized mortality ratio (95% limits)
Blohmke et al (1984)	German/Austrian residents	Lung cancer patients showed lack of nervousness, high social conformity and strong external control compared to controls
Grossarth-Maticek et al (1985)	Yugoslavian residents	3.27(p<0.001)

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

111. Respiratory symptoms

Details of studies which attempted to relate the risk of lung cancer to the presence of respiratory symptoms are shown in Table 111. Relative risks ranging from 0.8-3.23 were estimated, with thirteen out of fourteen being above 1.00.

Due to the reported associations between cigarette smoking, respiratory symptoms and lung cancer, all of the studies collected information on the respondents' smoking habits. However, as noted by Wynder and Fairchild, due to the strong correlation in this study between cigarette smoking and lung cancer and cigarette smoking and persistent cough, it was difficult to properly evaluate the correlation of cough to lung cancer, independent of cigarette smoking.

Therefore, despite the evidence presented in the table suggesting a possible association between the presence of respiratory symptoms and lung cancer risk, such a relationship cannot be regarded as established.

Table 111: Estimates of relative risk for respiratory symptoms

Study	Population	Symptoms	Relative risk (95% limits)
Denoix et al (1958)	French men	BRON	2.00(0.95-4.22)[1]
Wynder and Fairchild (1965)	US men	BRON	3.23(1.61-6.48)[1]
		COU	2.76[1](p<0.001)
		FLU	1.24(0.71-2.16)[1]
		PND	1.87(1.09-3.20)[1]
		SINU	1.85(1.05-3.26)[1]
Tenkanen et al (1987)	Finnish men	PHL	2.0(p<0.001)
		SOB	2.2(p<0.001)
		WHE	2.0(p<0.001)
Vestbo et al (1991)	Danish men	BRON	0.8(0.3-2.7)[2]
		COU	2.5(1.3-5.0)[2]
		PHL	1.5(0.7-3.2)[2]
		PHLC	1.2(0.5-3.0)[2]
		SOB	2.2(1.0-4.9)[2]

2501209055

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. Blohmke M, von Engelhardt B and Stelzer O (1984) Psychosocial factors and smoking as risk factors in lung carcinoma. J Psychosomatic Res, 28, 221-229.

2. Grossarth-Maticek R, Bastiaans J and Kanazir DT (1985) Psychosocial factors as strong predictors of mortality from cancer, ischaemic heart disease and stroke: The Yugoslav prospective study. J Psychosomatic Res, 29, 167-176.

2501209056

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

112. The rubber industry

Details of the studies which investigated lung cancer risk amongst workers in the rubber industry are given in Table 112. Eighteen standardized mortality ratios, ranging between 47 and 434, were given, with 12 being raised. Five relative risks, of 1.4-2.3, were estimated, and one study also gave an incidence ratio of 126.

Workers in the rubber industry are likely to be exposed to a combination of chemicals, in the form of dusts, vapours, condensed volatiles, solvents and gases, which will vary depending on the stage of the manufacturing process. Many of the materials which occur in rubber factories have been shown experimentally to be mutagenic or carcinogenic, and these include mineral oils, carbon black (extracts), curing fumes, some monomers, solvents, nitroso compounds and aromatic amines, thiurams and dithiocarbamate compounds, ethylenethiourea, di(2-ethylhexyl) phthalate, di(2-ethylhexyl) adipate and hydrogen peroxide [2]. However, due to a lack of historical industrial hygiene data none of the studies could accurately ascertain exposure, although some (Baxter and Werner, Delzell, Fox, McMichael 1976, Monson and Fine, Monson and Nakano 1976b, Parkes, Zhang) did attempt to classify workers into particular job categories as a substitute for exposure categories. Thus, attempting to evaluate the potential carcinogenicity of any one compound will be extremely difficult.

In their assessment of the rubber industry in 1982, IARC stated that "the combination of chemical exposures that occurs in the rubber industry is probably more relevant to the cancer pattern observed than are single compounds or groups of compounds. The variety of exposures increases the likelihood that there are interactive effects between two or more such agents" [2]. It was felt that there was "sufficient" evidence for the carcinogenicity in humans of exposures associated with the rubber industry [2,3].

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Footnote to Table 111

BRON = bronchitis; COU = cough; FLU = influenza; PHL = phlegm; PHLC = chronic phlegm; PND = postnasal drip; SINU = sinusitis; SOB = shortness of breath; WHE = wheezing

1 Estimated from data given

2 Tumours of respiratory system

References

1. Denoix PF, Schwartz D and Anguera G (1958) French investigation into the etiology of broncho-pulmonary cancer. Detailed analysis. Bull Assoc Franc pour l'etude du cancer, 49: 1-37.

2. Tenkanen L, Hakulinen T and Teppo L (1987) The joint effect of smoking and respiratory symptoms on risk of lung cancer. Int J Epidemiol, 16, 509-515.

3. Vestbo J, Knudsen KM and Rasmussen FV (1991) Are respiratory symptoms and chronic airflow limitation really associated with an increased risk of respiratory cancer? Int J Epidemiol, 20, 375-378.

4. Wynder EL and Fairchild EP (1965) The role of a history of persistent cough in the epidemiology of lung cancer. Am Rev Resp Dis, 94, 709-720.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Table 112: Estimates of relative risk/standardized mortality ratio for workers in the rubber industry

Study	Population	Relative risk (95% limits)
Fox et al (1974)	British rubber workers	118*
McMichael et al (1974)[1]	US rubber workers	83*
Andjelkovich et al (1976)[1]	US rubber workers	83*
Fox and Collier (1976)[1]	British rubber workers	127*
McMichael et al (1976a,b)[1]	US Receivers/shippers	1.9[2]
	Compounders/mixers	1.4[2]
	Mill-mixers	2.1[2]
	Extruders	1.4[2]
	Reclaimers	2.3[2]
Monson and Nakano (1976a)[1]	US rubber workers	92*
Monson and Nakano (1976b)[1]	US female non-tyre rubber workers	333*
Andjelkovich et al (1977)[1]	US workers exposed to synthetic latex	434*
Andjelkovich et al (1978)[1]	US female rubber workers	191*[3]
Monson and Fine (1978)[1]	US tyre curers	220*[3]
	Tyre moulders	200*[3]
	Fuel cell/deicer manufacturers	158*[3]
Baxter and Werner (1980)[1]	British rubber workers	115*[3]
Bovet and Lob (1980)[1]	Swiss rubber workers	47*
Delzell and Monson (1981)[1]	US rubber workers	84*
Kilpikari et al (1981)[1]	Finnish rubber workers	150*[2]
Delzell et al (1982)[1]	US tyre workers - mortality	99*
	Incidence	126
Parkes et al (1982)[1]	British rubber workers	122*
Zhang et al (1989)	Chinese rubber workers	133*

* Standardized mortality ratio

1 From IARC (1982)

2 Tumours of respiratory system

3 Estimated from data given

2501209059

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. Fox AJ, Lindars DC and Owen R (1974) A survey of occupational cancer in the rubber and cablemaking industries: Results of five-year analysis, 1967-71. Br J Ind Med, 31, 140-151.

2. International Agency for Research on Cancer (1982) Monographs on the evaluation of the carcinogenic risk of chemicals to humans. Volume 28: The rubber industry. IARC, Lyon.

3. International Agency for Research on Cancer (1987) Monographs on the evaluation of carcinogenic risks to humans. Supplement 7: Overall evaluations of carcinogencity: An updating of IARC monographs volumes 1 to 42, 332-334. IARC, Lyon.

4. Zhang Z-F, Yu S-Z, Li W-X and Choi BCK (1989) Smoking, occupational exposure to rubber, and lung cancer. Br J Ind Med, 46, 12-15.

2501209060

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

113. Schizophrenia

Table 113 gives details of the three studies which investigated the risk of lung cancer in relation to schizophrenia. A relative risk of 0.33 was given for lung cancer incidence, while the other two studies reported that lung cancer mortality among schizophrenics was either equal to or lower than that of other populations.

One author (Mortensen) felt that the lower risk of lung cancer observed could be due to a reduced exposure to carcinogens such as cigarette smoke among schizophrenic patients. However, the other two commented on the fact that the patients in their studies showed a high prevalence of smoking, of up to 90%. In the light of this, the reduced incidence of lung cancer seems even more surprising.

While the evidence presented in the table appears to suggest a reduced risk of lung cancer among schizophrenic patients, with only three studies reporting it is difficult to make a full evaluation.

Table 113: Estimates of relative risk for schizophrenic patients

Study	Location	Relative risk (95% limits)
Anon (1986)	USA	Schizophrenic patients had lower lung cancer mortality than controls
Gopalaswamy and Morgan (1986)	Not stated	Schizophrenics' lung cancer mortality no higher than general population
Mortensen (1989)	Denmark	0.33($p<0.001$)[1]

1 Incidence

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

References

1. Anon (1986) Br Med J, 293, 700.

2. Gopalaswamy AK and Morgan R (1986) Smoking in chronic schizophrenia. Br J Psych, 149, 523.

3. Mortensen PB (1989) The incidence of cancer in schizophrenic patients. J Epidemiol Community Health, 43, 43-47.

2501209062

Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

114. Selenium

Table 114 gives details of the five studies which investigated the possible association between lung cancer risk and selenium levels.

A correlation study found evidence of lower lung cancer mortality rates in areas with higher selenium levels in forage crops, with mortality rates per 100,000 of 32.37, 33.25 and 40.06 for men in high, medium and low selenium areas respectively, and 5.45, 5.73 and 6.33 respectively for women.

Two of the studies measuring dietary selenium intake used high intake as a baseline. One of these studies estimated a relative risk of 6.00 for low selenium intake in one population considered, but failed to find an association, or to give detailed results for the other. The other study found lower selenium levels in lung cancer cases in three populations studied, but higher levels in cases in two populations. Again, detailed results were not presented.

A study of Dutch subjects, in which those with a high dietary intake of selenium were compared to those with a low intake, estimated a relative risk of 0.50.

Finally, a study of occupational selenium exposure found lower levels in the lung tissue of lung cancer cases than in that of two control groups.

The major drawback with the studies which investigated dietary selenium intake is that it is well known that selenium cannot be measured accurately by a dietary questionnaire alone, since the level in the food is dependent on the level in the soil in which it was grown. The study by van den Brandt measured selenium levels in the respondents' toenail clippings as well as administering a dietary questionnaire, thus providing a more objective measure of selenium. However, the studies by Comstock and Fontham did not appear to have taken any such measurements.

Another problem is that the development of cancer may affect appetite or the way in which food is metabolized, either of which could affect selenium levels measurable in the body. Therefore, the study by Fontham, using a case-control design in which information on selenium levels was collected after the subject had developed cancer may have introduced bias into the results. Similar problems may have occurred in the study by Gerhardsson.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Therefore, despite the findings presented in the table suggesting a possible protective effect of selenium against lung cancer, the relationship is far from proven. Indeed, after a recent review of the data IARC concluded that the evidence for such an effect was "not convincing" [3].

Table 114: Estimates of relative risk/mortality rate for selenium

Study	Population	Relative risk (95% limits)
Correlation study:		
Shamberger et al (1976)	US men, high selenium area	32.27[1]
	Medium selenium area	33.25[1]
	Low selenium area	40.06[1]
	Women, high selenium area	5.45[1]
	Medium selenium area	5.73[1]
	Low selenium area	6.33[1]
Low dietary selenium:		
Fontham (1990)	Not stated	No association reported
	Finnish residents	6.00
Comstock et al (1992)	Finnish males	Serum selenium levels lower in cases than controls (p>0.05)
	Finnish females	Serum selenium levels lower in cases than controls (p>0.05)
	US residents	Serum selenium levels lower in cases than controls (p<0.05)
	Hawaiian residents	Serum selenium levels higher in cases than controls (p>0.05)
	US residents	Serum selenium levels higher in cases than controls (p>0.05)

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

Table 114 continued

High dietary selenium:		
Van den Brandt et al (1993a,1993b)	Dutch residents	0.50(0.30-0.81)
Occupational exposure:		
Gerhardsson et al (1985)	Swedish smelter workers	Selenium level in lung tissue 71ppb in cases compared to 110ppb and 136ppb in controls

1 Mortality rate per 100,000

References

1. Comstock GW, Bush TL and Helzlsouer K (1992) Serum retinol, beta-carotene, vitamin E, and selenium as related to subsequent cancer of specific sites. Am J Epidemiol, 135, 115-121.

2. Fontham ETH (1990) Protective dietary factors and lung cancer. Int J Epidemiol, 19 (Suppl 1), S32-S42.

3. Gerhardsson L, Brune D, Nordberg GF and Wester PO (1985) Protective effect of selenium on lung cancer in smelter workers. Br J Ind Med, 42, 617-626.

4. International Agency for Research on Cancer (1975) Monographs on the evaluation of carcinogenic risk of chemicals to man. Volume 9: Some aziridines, N-, S- and O-mustards and selenium, 245-260. IARC, Lyon.

5. Van den Brandt PA, Goldbohm RA, van't Veer P et al (1993a) Toenail selenium and the risk of lung, gastrointestinal, and breast cancer: A prospective study. Am J Epidemiol, 138, 626-627 (Abstract).

6. Van den Brandt PA, Goldbohm RA, van't Veer P et al (1993b) A prospective cohort study on selenium status and the risk of lung cancer. Cancer Res, 53, 4860-4865.

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115. Shellfish/crustaceae

Details of the only study found which attempted to relate the risk of lung cancer to consumption of shellfish and crustaceae are given in Table 115. It was reported that 36% of cases and 26% controls consumed cooked shellfish, while 16% of cases and 10% controls were consumers of crustaceae.

With only one study reporting it is not really possible to evaluate the potential carcinogenicity to humans of shellfish or crustaceae.

Table 115: Frequency of consumption of shellfish/crustaceae

Study	Population	Observations
Denoix et al (1958)	French men	36% bronchial cancer cases consumed cooked shellfish compared to 26% controls ($p<0.001$); 16% bronchial cancer cases consumed crustaceae compared to 10% controls ($p<0.01$)

References

1. Denoix PF, Schwartz D and Anguera G (1958) French investigation into the etiology of broncho-pulmonary cancer. Detailed analysis. Bull Assoc Franc pour l'etude du cancer, 49: 1-37.

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116. Silica

The numerous studies found which contained some data relevant to an investigation of the possible association between exposure to silica and the risk of lung cancer are detailed in Table 116. From the table, it can be seen that, of the 40 estimates of relative risk given ranging from 0.2-7.9, some 34 were above 1.00. The 26 standardized mortality ratios calculated lay in the range 84-590, with 22 of them being raised. Fourteen proportional mortality ratios were given, of between 75 and 348, of which 13 were raised. Additionally, one study gave an mortality odds ratio of 1.5.

From the table it can be seen that the study subjects came from many different occupational backgrounds. It is likely that the respondents were exposed to substances other than silica, which may themselves be potential carcinogens, in the course of their work and the nature of these exposures will vary from job to job. Data on the level of exposure to silica were only available from 13 of the studies (Davis, Gibson, Hessel and Sluis-Cremer, Hessel et al, Higgins, Kjuus, Koskela 1976, Lawler, McLaughlin, Meijers, Sherson and Iversen, Silverstein, Thomas and Stewart), and even fewer measurements of exposures to other substances were made. Therefore it is difficult to draw any firm conclusions about the role of silica in the development of lung cancer. Furthermore, all of the studies concentrated on the effects of crystalline silica, with none presenting results for amorphous silica.

Lastly, as IARC noted, there are some potential problems in the design of some of the studies. In particular there was some doubt as to the comparability of reference groups in several of the studies (Chiyotani, Costello and Graham, Davis, Pham, Vutuc, Westerholm 1986, Zambon), and the comprehensiveness with which some studies had taken into account the effects of possible confounding variables (Brown, Finkelstein 1982, Katsnelson and Mokronosova, Lawler, Muller, Neuberger, Selikoff, Thomas). Other problems which may have introduced inaccuracies into the studies, particularly those based on silicosis sufferers, included differences between countries in the definition of compensable silicosis, potential differences in disease detection methods, and unorthodox methods of calculating results [1,5].

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Therefore, it was felt that the evidence for the carcinogenicity to humans of crystalline silica was "limited", while that for amorphous silica was "inadequate" [5,6].

Table 116: Estimates of relative risk/standardized mortality ratio for exposure to silica

Study	Population	Relative risk (95% limits)
Redmond (1975)[1]	US masons	2.12(p<0.01)
	Foundrymen	1.62
	Blacksmiths	2.42(p<0.05)
Koskela et al (1976)[1]	Finnish foundry workers	151*
Milham (1976)[1]	US metal moulders	312[2]
	Mine operatives/labourers	179(p<0.05)[2]
Gibson et al (1977)[1]	Canadian foundrymen	5.0(p<0.0005)
Selikoff (1978)[3]	US tunnel workers	160*
Armstrong et al (1979)[3]	Australian gold miners	140(p<0.05)*
Decoufle and Wood (1979)[1]	Iron foundry workers	200*
Egan et al (1979)[1]	US moulders - whites	147(p<0.01)[2]
	Blacks	180[2]
Katsnelson and Mokronosova (1979)[1]	Gold miners - underground	7.9(p<0.001)
	Surface miners	1.6
	Firebrick plant workers	2.0(p<0.05)
Puntoni et al (1979)[1]	Italian sandblasters	3.8(p<0.05)
Tola et al (1979)[1]	Finnish foundry workers	144(p<0.05)[2]
Peterson and Milham (1980)[1]	US metal moulders	192(p<0.05)[2,4]
	Mine operatives/labourers	138(p<0.05)[2]
Westerholm (1980)[3]	Swedish miners/quarrymen/ tunnellers with silicosis diagnosed 1931-48	590(p<0.01)*
	Diagnosed 1949-69	380(p<0.01)*
	Iron/steel workers with silicosis diagnosed 1949-69	220(p<0.05)*
Egan-Baum et al (1981)[1]	Iron foundry workers	2.4(1.01-5.3)

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Table 116 continued

Redmond et al (1981)[1]	US blacksmiths	1.89(p<0.05)
Costello (1982)[1]	Metal ore miners	127(p<0.01)*
Finkelstein et al (1982)[1]	Canadian miners	198(p<0.01)*
Fletcher (1982)[1]	English foundrymen	147(120-180)*
Milham (1982)[1]	Sandblasters	348(p<0.01)[2]
Thomas (1982)[1]	US pottery workers	180(p<0.01)[2]
Davis et al (1983)[3]	US granite workers	118*[5]
Higgins et al (1983)[3]	US taconite miners	84*
Lawler et al (1983)[3]	US haematite miners - surface	88*
	Underground	100*
Muller et al (1983)[3]	Canadian miners	145(p<0.001)*
Pham et al (1983)[3]	French iron miners	3.5(1.9-6.0)
Vutuc (1983)[3]	Austrian stone workers	2.0(p<0.01)
Gudbergsson et al (1984)[3]	Finnish silicotics	3.0(1.5-5.3)
Chiyotani (1984)[3]	Japanese silicotics	653
Puntoni et al (1985)[3]	Italian refractory plant workers with silicosis	167*
	Non-silicotics	208*
Rubino et al (1985)[3]	Italian silicotics	1.36(p<0.05)
Brown et al (1986)[3]	US gold miners	100*
Costello and Graham (1986)[3]	US granite workers	1.00
Finkelstein et al (1986)[3]	Canadian ceramic/pottery/ granite/quarry workers, silica brickmakers, sand-blasters with silicosis	302(p<0.01)*
Fletcher (1986)[3]	UK foundry workers	149(p<0.001)*
	Skilled moulders	125(p<0.05)[2]
	Semiskilled moulders	154(p<0.05)[2]
	Dressers	75[2]
	Labourers	106[2]
Forastiere et al (1986)[3]	Italian pottery workers	2.0(1.1-3.5)
Hessel and Sluis-Cremer (1986)[3]	South African miners	1.1
Kjuus et al (1986)[3]	Norwegian ferroalloy workers	1.00
Kurppa et al (1986)[3]	Finnish silicotics	312(230-414)*

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Table 116 continued

Lynge et al (1986)[6]	Finnish/Danish stone cutters	>1.00
	Swedish/Norwegian stone cutters	1.00
	Finnish excavation workers	>1.00
	Danish glass workers	>1.00
	Nordic ceramics workers	1.00
	Nordic metal miners	1.0-5.0
	Nordic foundry workers	>1.00
Neuberger et al (1986)[3]	Austrian silicotics	148($p<0.001$)*
Schuler and Ruttner (1986)[3]	Swiss silicotics	2.41($p<0.05$)
Sherson and Iversen (1986)[3]	Danish foundry workers	115*
Silverstein et al (1986)[3]	US iron foundry workers	148[2]
Steenland and Beaumont (1986)[3]	US members of Granite Cutters Union	1.19(0.97-1.5)
Westerholm et al (1986)[3]	Miners/quarrymen/tunnellers	4.1($p<0.05$)
	Iron/steel workers	1.8
Zambon et al (1986)[3]	Italian silicotics	228($p<0.05$)*
Koskela et al (1987)[6]	Finnish granite workers	129*[5]
Thomas and Stewart (1987)[6]	US pottery workers	137*
Mastrangelo et al (1988)[7]	Silicotics	1.9($p<0.05$)
Forastiere et al (1989)[7]	Silicotics	1.5($p<0.05$)[8]
Infante-Rivard et al (1989)	Canadian silicotics	3.47(3.11-3.90)
Amandus and Costello (1990)[7]	Miners with silicosis	2.0($p<0.05$)
Hessel et al (1990)	South African gold miners	Cases and controls comparable for silica dust exposure
Meijers et al (1990)	Dutch ceramics workers	1.11(0.77-1.6)
Ng et al (1990)[7]	Silicotics	2.0($p<0.05$)
Amandus et al (1991)	Workers in US dusty trades industry	2.3(1.5-3.4)
McLaughlin et al (1992)	Pottery workers	2.2(0.8-6.3)[5]
	Tungsten miners	0.5(0.3-1.0)
	Iron-copper miners	0.2(0.1-0.5)
	Tin miners	2.5(1.3-4.8)

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Footnote to Table 116

* Standardized mortality ratio

1 From Goldsmith (1982)

2 Proportional mortality ratio

3 From International Agency for Research on Cancer (1987a)

4 Tumours of respiratory system

5 Estimated from data given

6 From International Agency for Research on Cancer (1987b)

7 From Amandus (1991)

8 Mortality odds ratio

References

1. Amandus HE, Shy C, Wing S, Blair A and Heineman EF (1991) Silicosis and lung cancer in North Carolina dusty trades workers. Am J Ind Med, 20, 57-70.

2. Goldsmith DF, Guidotti TL and Johnston DR (1982) Does occupational exposure to silica cause lung cancer? Am J Ind Med, 3, 423-440.

3. Hessel PA, Sluis-Cremer GK and Hnizdo E (1990) Silica exposure, silicosis, and lung cancer: a necropsy study. Br J Ind Med, 47, 4-9.

4. Infante-Rivard C, Armstrong B, Petitclerc M, Cloutier L-G and Theriault G (1989) Lung cancer mortality and silicosis in Quebec, 1938-85. The Lancet, Dec 23/30, 1504-1507.

5. International Agency for Research on Cancer (1987a) Monographs on the evaluation of the carcinogenic risk of chemicals to humans. Volume 42: Silica and some silicates, 39-144. IARC, Lyon.

6. International Agency for Research on Cancer (1987b) Monographs on the evaluation of carcinogenic risks to humans. Supplement 7: Overall evaluations of carcinogenicity: An updating of IARC mongraphs volumes 1 to 42, 341-343. IARC, Lyon.

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Source: https://www.industrydocuments.ucsf.edu/docs/nhhl0000

7. McLaughlin JK, Chen J-Q, Dosemeci M et al (1992) A nested case-control study of lung cancer among silica exposed workers in China. Br J Ind Med, 49, 167-171.

8. Meijers JMM, Swaen GMH, Volovics A, Slangen JJM and Van Vliet K (1990) Silica exposure and lung cancer in ceramic workers: A case-control study. Int J Epidemiol, 19, 19-25.

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